

Remarks

Reconsideration of this Application is respectfully requested.

Upon entry of the foregoing amendment, claims 3, 4, 6, 7, 9, 10, 12, 13, 16-18, 20-32, 35-65, 67, and 68 are pending in the application, with 6, 13, 18, 38 and 60 being the independent claims. Claims 8 and 66 are sought to be cancelled without prejudice to or disclaimer of the subject matter therein. Claims 1, 2, 5, 11, 14, 15, 19, 33 and 34 were previously cancelled. Claims 18, 20-32, and 35-37 were previously withdrawn. Claims 6 and 60 are sought to be amended. These changes are believed to introduce no new matter, and their entry is respectfully requested.

Based on the above amendment and the following remarks, Applicants respectfully request that the Examiner reconsider all outstanding objections and rejections and that they be withdrawn.

Objections to the Drawings

Paragraph 3 of the Office Action states that the drawings were objected to under 37 C.F.R. 1.83(a). Paragraph 3 further states "the 'substrate having a plurality of contact pads on a first surface electrically connected through said substrate to a plurality of solder ball pads on a second surface of said substrate' must be shown or the feature(s) canceled from the claim(s) (See Claims 6, 13 and 38)." Applicants assert that contact pads and solder ball pads were shown in the originally filed drawings, including FIGS. 5-10. However, Applicants have modified Figures 5, 7, 9, and 10 to include examples further showing the claimed features mentioned above, as shown in the concurrently attached three replacement sheets. Example support for these drawing changes is provided in the specification on page 9, which states:

As described above, the BGA package substrate provides vias and routing on one or more layers to connect contact pads for wire bonds on its upper surface to solder balls attached to the bottom substrate surface.

Three annotated sheets are also attached, highlighting the modifications in red. For example, FIGS. 5 and 7 each are modified to show examples of routing and vias for substrate 104. An originally present contact point 120 (e.g., contact pad) for wire bond 108 is shown electrically connected through substrate 104 by vias and routing to a solder ball 106 on the bottom of substrate 104, which is attached to a solder ball pad on the bottom of substrate 104. Original FIGS. 6 and 8 each show a plurality of example contact points 120 on the top surface of substrate 104. FIGS. 9 and 10 each are modified to show additional examples of vias for substrate 104. Furthermore, FIGS. 9 and 10, as originally filed, each show conductive pads (e.g., contact pads) (labeled as conductive pads 904 in FIG. 9) that are electrically connected by routing (not shown) and vias to solder ball pads of solder balls 106.

Thus, Applicants respectfully request that the Examiner reconsider and withdraw this objection.

Rejections under 35 U.S.C. § 103

Claims 6-9, 50, 60, 61, and 64-67

In paragraph 5 of the Office Action, claims 6, 7, 50, 60, 61, 64, 65, and 67 were rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 5,903,052 to Chen *et al.* (hereinafter Chen) in view of U.S. Patent No. 6,117,797 to Hembree (hereinafter Hembree). Applicants respectfully traverse the rejection, and request that it be withdrawn.

Technical differences exist between Chen and Hembree and the claimed embodiments of the present invention. Claim 6 is shown amended above to recite a wire bond that couples a contact pad of the first surface of the IC die to the first surface of the heat spreader, as was previously recited in cancelled claim 8. At least this feature is not taught or suggested by Chen and Hembree, alone or in combination. Accordingly, Applicants respectfully submit that independent claim 6 is patentable over Chen and Hembree, for at least these reasons.

In paragraph 6 of the Office Action, claims 8, 9, and 66 were rejected under 35 U.S.C. 103(a) as being unpatentable over Chen in view of Hembree and Japanese Patent No. 1018935 to Kinseisha (hereinafter Kinseisha). Applicants respectfully traverse this rejection as if applied to claim 6 as amended.

Kinseisha describes a laminated semiconductor package. The abstract of Kinseisha states "[a] *first heat sink (5) is coupled with a predetermined wiring bonding pad* to discharge heat of the semiconductor chip to the external surface" (italics added). Furthermore, FIG. 5 of Kinseisha shows first heat sink 5 coupled to the surface of semiconducting chip 1 where wire bonding pads are located. Thus, Kinseisha does not disclose a wire bond contacting the heat sink and contact pad, as is asserted in paragraph 6 of the Office Action. Heat sink 5 is directly coupled to wire bonding pads. Thus, Kinseisha does not teach or even suggest a wire bond (or equivalent) that couples a contact pad of the first surface of the IC die to the first surface of the heat spreader, as recited in claim 6.

Accordingly, Applicants respectfully submit that independent claim 6 is patentable over Chen, Hembree, and Kinseisha, alone or in combination, for at least these reasons. Likewise, independent claim 60 is also patentable over Chen, Hembree, and Kinseisha for at least these reasons, and further in view of its own features. Furthermore, claims 7, 9, 50, 60, 61, 64, 65, and 67, which depend from independent claims 6 and 60, are also patentable for at least these reasons, and further in view of their own features.

Claims 8 and 66 were cancelled. Applicants therefore request that the Examiner reconsider and withdraw the rejection of these claims.

Claims 38-49, 51, 3, 4, and 12

In paragraph 9 of the Office Action, claims 38-49, 51, 3, 4, and 12 were rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 6,545,351 to Jamieson *et al.* (hereinafter Jamieson) in view of Chen. Applicants respectfully traverse this rejection.

Jamieson relates to a plastic ball grid array (PBGA) package (see col. 1, lines 13-17). PBGA packages have rigid plastic substrates. For example, FIG. 1 shows such a PBGA package having a rigid substrate 2. As shown in FIG. 1 no stiffening of substrate 2 over its entire length is provided. A heat slug 30 is attached to the bottom of substrate 2, directly underneath an integrated circuit 1 attached to the top side of substrate 2.

Independent claim 38 of the present invention is shown below:

38. A ball grid array (BGA) package, comprising:

a substrate having a plurality of contact pads on a first surface electrically connected through said substrate to a plurality of solder ball pads on a second surface of said substrate;

an integrated circuit (IC) die having opposing first and second surfaces, said first surface of said IC die including at least one contact pad, said second surface of said IC die being mounted to said first surface of said substrate;

a heat spreader that has a first surface and a second surface, wherein said first surface of said heat spreader is attached to said second surface of said substrate; and

a ring shaped stiffener being centrally open in a first surface and a second surface, wherein said first surface of said ring shaped stiffener is attached to said first surface of said substrate;

wherein said second surface of said heat spreader is capable of being coupled to a printed circuit board (PCB).

The Office Action attempts to combine, among other things, "a stiffener" of Chen (i.e., dielectric supporting member 24) with substrate 2 and heat slug 30 of Jamieson to reject claim 38. However, as stated in M.P.E.P. § 2143:

To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings.

As further described below, no such suggestion or motivation to combine Jamieson and Chen is present to establish a *prima facie* case of obviousness. Thus, claim 38 is patentable over Jamieson and Chen.

For example, page 10 of the Office Action states:

Chen discloses a stiffener connected to the substrate (For Example: See Figure 3b). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the semiconductor device of Jamieson to include a stiffener connected to the substrate as disclosed in Chen because it aids in providing a good efficiency of heat spreading (For Example: See Column 2 Lines 8-33).

However, because the substrate of Jamieson is already rigid or stiff, no stiffening of the substrate of Jamieson is needed. Thus, Jamieson actually *teaches away* from including any stiffener of Chen.

Furthermore, even assuming, *arguendo*, that the "dielectric supporting member 24" of Chen was attached to substrate 16 of Jamieson, any benefit in "efficiency of heat spreading," as asserted in the Office Action, would be minimal. For example, this is because heat would primarily have to transfer from integrated circuit 12 across substrate 16 to dielectric supporting member 24 in order for dielectric supporting member 24 to be involved in heat spreading. This would be a significant distance for heat to transfer, taking into account that space on substrate 16 is needed around integrated circuit 12 for wire bond connections. Furthermore, heat slug 30 would provide little or no benefit in transferring heat to dielectric supporting member 24 of Chen. As shown in FIGS. 2-4, heat slug 30 of Jamieson is located only under integrated circuit 12. Heat slug 30 would therefore not be located under any portion of dielectric supporting member 24. Thus, heat slug 30 would be even further away from the dielectric supporting member 24 than would be integrated circuit 12. Thus, the path for heat from heat slug 30 to dielectric supporting member 24 would be even longer.

For at least these reason, no motivation or suggestion appears to be present to combine Chen and Jamieson, as is required for a *prima facie* case of obviousness. In fact, the references appear, if anything, to teach away from the combination.

Accordingly, Applicants respectfully submit that independent claim 38 is patentable over Jamieson and Chen, alone or in combination, for at least these reasons. Likewise, independent claim 60 is also patentable over Chen, Hembree, and Kinseisha for at least these reasons, and further in view of its own features. Furthermore, claims 39-49, 51, 3, 4, and 12, which depend therefrom, are also patentable for at least these reasons, and further in view of their own features. Applicants therefore request that the Examiner reconsider and withdraw the rejection of these claims.

Claim 10

In paragraph 7 of the Office Action, claim 10 was rejected under 35 U.S.C. 103(a) as being unpatentable over Jamieson in view of Chen and Japanese Patent No. 2000286294 to Shimbamoto *et al.* (hereinafter Shimbamoto). Applicants respectfully traverse this rejection.

Applicants respectfully submit that Shimbamoto does not supply the teachings missing from Jamieson and Chen, with respect to independent claim 38. Therefore, claim 10, which depends therefrom, is also patentable over these references for at least the reasons above, and further in view of its own features. Applicants therefore request that the Examiner reconsider and withdraw the rejection of claim 10.

Claim 13

In paragraph 8 of the Office Action, claim 13 was rejected under 35 U.S.C. 103(a) as being unpatentable over Jamieson in view of Hembree and Chen. Applicants respectfully traverse this rejection.

Applicants respectfully submit that Hembree does not supply the teachings missing from Jamieson and Chen, with respect to independent claim 38, and that claim 13 is patentable over Jamieson, Chen, and Hembree, alone or in combination, for at least these reasons, and further in view of its own reasons.

For example, claim 13 recites "an IC die is mounted to said first surface of said substrate in a flip chip configuration, wherein a conductive bump on an active surface of said IC die is connected to a conductive pad on said first surface of said substrate." Jamieson, Chen, and Hembree do not teach or suggest this feature of claim 13.

Applicants therefore request that the Examiner reconsider and withdraw the rejection of claim 13.

Claims 16, 17, and 52-59

In paragraph 10 of the Office Action, claims 16, 17, and 52-59 were rejected under 35 U.S.C. 103(a) as being unpatentable over Jamieson in view of Hembree, Chen, and U.S. Patent No. 5,901,041 to Davies. Applicants respectfully traverse this rejection.

Applicants respectfully submit that Davies does not supply the teachings missing from Jamieson, Hembree, and Chen, with respect to independent claim 13, from which claims 16, 17, and 52-59 depend. Thus, Applicants assert that claims 16, 17, and 52-59 are patentable over Jamieson, Hembree, Chen, and Davies, alone or in combination, for at least these reasons, and further in view of their own reasons.

For example, contrary to the assertion in the Office Action with regard to claim 16, Davies does not disclose a semiconductor device, where the heat spreader 18 is attached to the heat sink 42 and die 12. As shown in FIG. 3, heat sink 42 is not attached to heat spreader 18. Thus, Davies does not teach or suggest "a second heat spreader attached to a non-active surface of said IC die and said second surface of said ring shaped stiffener," as recited in claim 16.

Furthermore, contrary to the assertion in the Office Action with regard to claim 17, Davies does not teach or suggest a via filled with a conductive material to couple said conductive bump to said heat spreader, as recited in claim 17.

Applicants therefore request that the Examiner reconsider and withdraw the rejection of these claims.

Claims 62 and 63

In paragraph 11 of the Office Action, claims 62 and 63 were rejected under 35 U.S.C. 103(a) as being unpatentable over Chen in view of Hembree and U.S. Patent No.

6,117,797 to Atwood *et al.* (hereinafter Atwood). Applicants respectfully traverse the rejection, and request that it be withdrawn.

Applicants respectfully submit that Atwood does not supply the teachings missing from Chen and Hembree, with respect to independent claim 60. Therefore, claims 62 and 63, which depend therefrom, are also patentable over these references for at least the reasons above, and further in view of their own features. Applicants therefore request that the Examiner reconsider and withdraw the rejection of claims 62 and 63.

Claim 68

In paragraph 12 of the Office Action, claim 60 was rejected under 35 U.S.C. 103(a) as being unpatentable over Chen in view of Hembree and Shimbamoto. Applicants respectfully traverse the rejection, and request that it be withdrawn.

Applicants respectfully submit that Shimbamoto does not supply the teachings missing from Chen and Hembree, with respect to independent claim 60. Therefore, claim 60, which depends therefrom, is also patentable over these references for at least the reasons above, and further in view of its own features. Applicants therefore request that the Examiner reconsider and withdraw the rejection of claim 68.

Double Patenting

Paragraphs 14 and 15 of the Office Action state that claims 3, 4, 6-10, 12, 13, 16, 17, and 38-68 are rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-13 of U.S. Patent Application No. 09/997,272, and over claims 1 and 11-13 of U.S. Application No. 09/984,259.

Paragraphs 16 and 17 of the Office Action state that claims 3-13, 16, 17, and 38-68 are rejected under the judicially created doctrine of obviousness-type double patenting

as being unpatentable over claims 1-17, 35, and 36 of U.S. Patent Application No. 09/783,034, and over claims 1-33 and 57 of U.S. Application No. 09/742,366.

Applicants respectfully request that these rejections continue to be held in abeyance until allowable subject matter is indicated.

Conclusion

All of the stated grounds of objection and rejection have been properly traversed, accommodated, or rendered moot. Applicants therefore respectfully request that the Examiner reconsider all presently outstanding objections and rejections and that they be withdrawn. Applicants believe that a full and complete reply has been made to the outstanding Office Action and, as such, the present application is in condition for allowance. If the Examiner believes, for any reason, that personal communication will expedite prosecution of this application, the Examiner is invited to telephone the undersigned at the number provided.

Prompt and favorable consideration of this Amendment and Reply is respectfully requested.

Respectfully submitted,

STERNE, KESSLER, GOLDSTEIN & FOX P.L.L.C.

A handwritten signature in black ink, appearing to read "Mr. J. W.", with a large, stylized initial "J" and a horizontal line extending to the right.

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Date: 2-6-04

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